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EXAMINER	
WEI, ZHENG	
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No. 10/784,753	Applicant(s) GUSTAFSON ET AL.	
	Examiner Zheng Wei	Art Unit 2192	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 22 October 2007.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-17 and 30-37 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☐ Claim(s) 1-17 and 30-37 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 23 February 2004 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Remarks

1. This office action is in response to the amendment filed on 10/22/2007.
2. Claims 18-29 have been canceled.
3. Claims 1, 4, 5, 6, 9 and 30 have been amended.
4. Claims 31-37 have been added.
5. The Claim objection to claims claim 1, 6 26, 28 and 29 is withdrawn in view of the Applicant's amendment.
6. The 35 U.S.C. 112 second paragraph rejections of claims 1-30 are withdrawn in view of the Applicant's amendment.
7. The 35 U.S.C. § 101 rejection to claims 18-29 is withdrawn in view of the Applicant's cancellation of said claims.
8. Claims 1-17 and 30-37 remain pending and have been examined.

Response to Arguments

9. Applicant's arguments filed on 10/22/2007, in particular on pages 9-11, have been fully considered but they are not persuasive. For example:
   - At page 10 last paragraph, the Applicant contends that <u>Aberth</u> is silent with respect to cited limitation in claims about tracking operations performed on a floating point value; determining an error and determining which of the operation caused the error. However, the Examiner respectfully disagrees. As

in the cited prior art, Aberth discloses a test function test(A, I, J) to test error and use a global parameter "test_failure" to carry out the test result (see for example, p.486, section 4. "Range Arithmetic in C++"; also see code example at p.488 and related text). Therefore, Kolawa and Aberth do disclose all the limitations in the claims.

Claim Rejections - 35 USC § 103

10. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

11. Claims 1-3, 6-11, 13-17 and 30-37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kolawa (US 6,085,029) in view of Aberth (Aberth et al., Precise Computation Using Range Arithmetic, via C++)

Claim 1:

Kolawa discloses a method for accuracy-aware analysis (error-checking) of a program, comprising:

- obtaining source code for the program (see for example, Fig.3, item 31 "Provide Source Code" and item 32 "Source Code File" and related text);
- instrumenting the source code to obtain instrumented source code (see for example, Fig.3, item 37 "Instrumentation', item 38 "Instrumented Parse Tree"

and related text; also see Fig.5c, step 75, "Insert Automatic Test Case Generation Instrumentation");

- compiling to instrumented source code to obtain instrumented compiled code (see for example, Fig.3, item 39, "Code Generation" and item 40, "Object Code File"; also see Fig.1, step 11, "Compilation Process" and related text); and
- executing the instrumented compiled code, wherein executing the instrumented compiled code (see for example, Fig.1, step 14, "Execution Process" and related text)

but does not explicitly disclose the source code comprises floating-point variable and using the accuracy-aware tracking structure to track an operation on the floating-point variable. However, Aberth in the same analogous art of accuracy-aware analysis (precise computation) discloses a method using range arithmetic to make the precision dynamically adjustable, and permit error monitoring by using an accuracy-ware tracking structure (test function) and data stored in the accuracy-ware tracking structure to determine error(global variable test_failure) (see for example, p.482, section 2, "Range Arithmetic", lines 2-3"; also see p.486, section 4. "Range Arithmetic in C++"; further see code example at p.488 and related text). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to use Aberth's method to instrument in Kolawa's invention to detect program accuracy (see for example, p.481, abstract section, lines 1-2, "for programming tasks requiring assured accuracy").

One would have been motivated to do so for automatically and dynamic debugging software program as suggested by Kolawa (see for example, lines 27-34)

Claim 2:

Kolawa and Aberth disclose the method of claim 1, Aberth further discloses the method comprising: generating an accuracy-aware analysis report using the accuracy-aware tracking structure (see for example, p.488, example code with output statement "cout<<" and related text).

Claim 3:

Kolawa and Aberth disclose the method of claim 2, Aberth further discloses wherein the accuracy-aware analysis report includes at least one tracking variable associated with the floating-point variable selected from the group consisting of an error variable, a scaled mantissa digits variable, a renormalization variable, a left digit destruction variable, and an operations variable (see for example, p.488, example code with output statement "cout<< 'f='" and related text; "f" is considered as output to indicate precision test failed).

Claim 6:

Kolawa and Aberth disclose the method of claim 3, Aberth further discloses wherein the error variable comprises an upper limit interval variable or a lower limit interval variable (see for example, p.488, lines 1-2, "The correct evaluation of f to the 15 decimal places of (3) is routine using range arithmetic"; also see example C++ code).

Claims 7 and 8:

Kolawa and Aberth disclose the method of claim 3, Aberth further discloses wherein ranged variables comprise at least one selected from the group consisting of a multiplication variable, a division variable, and a square root variable (see for example, p.486, section 4, Range Arithmetic in C++, lines 1-2, "We define the class rvar for ranged variables, with the four rational operation +, -, *, /, …".), but does not explicitly discloses an operations variable and a renomalization variable for tracking different operations. However, it is well known in the computer art that the variables in Aberth's disclosure could be used to track different operations according programmer's implementation. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to use different variables (operations variable and renomalization variable) to track different operation, e.q. +, _, *, /…)

Claim 9:

Kolawa and Aberth disclose the method of claim 1, Aberth further discloses wherein executing the compiled instrumented code comprises:

- performing one of the plurality of operations on the floating-point variable to obtain a result (see for example, p.488, example code for calculating the value of floating-point variable “f”);
- incrementing a tracking variable corresponding to one of the plurality of operations associated with the floating-point variable (see for example, p.488, example code for adding precision, “add_precision()”);
- determining whether the result is exact using a scaled mantissa of the result (see for example, p.488, example code for determining exact, “test()”); and
- quantifying error associated with the result if the result is not exact (see for example, p.488, example code for quantifying error, “if (test failure) add_precision()”).

Claim 10:

Kolawa and Aberth disclose the method of claim 9, Aberth further discloses the method comprising:

updating error variable using data obtained from quantifying the error associated with the result, if the result is not exact (see for example, p.488, example code for quantifying error, “if (test_failure) add_precision()”).

Claim 11:

<u>Kolawa</u> and <u>Aberth</u> disclose the method of claim 9, <u>Aberth</u> further discloses the method comprising: determining whether the result exceeds an accuracy threshold if the result is not exact (see for example, p.488, example code for setting threshold and determining accuracy, "set_precision(20)" and "test(f,1,15) and related text) .

Claim 13:

<u>Kolawa</u> and <u>Aberth</u> disclose the method of claim 11, <u>Aberth</u> further discloses he method, wherein the accuracy threshold comprises at least one selected from the group consisting of a relative error threshold, an absolute error threshold, and a comparison test (see for example, p.488, "Note the initial setting of precision at 20 decimal digits…").

Claim 14:

<u>Kolawa</u> and <u>Aberth</u> disclose the method of claim 1, <u>Aberth</u> further discloses the method comprising: setting an accuracy threshold for the program exact (see for example, p.488, example code for setting threshold, "set_precision(20)" and related text).

Claims 15-16:

Claims 15-16 use the same method as described in claim 1 above to update/modify instrumentation source code following the same steps, wherein all claimed limitation functions have been addressed and/or set forth above. Therefore, they also would have been obvious by Kolawa and Aberth.

Claim 17:

Kolawa and Aberth disclose the method of claim 1, Aberth further discloses wherein the floating-point variable is double type (see for example, p.487, Fig.1, "double floating point arithmetic" and related text)

Claims 30-37:

Claims 30-37 are system version for performing the claimed method as in claim 1-17 addressed above, wherein all claimed limitation functions have been addressed and/or set forth above and certainly a computer system would need to run and/or practice such function steps disclosed by reference above. Thus, they also would have been obvious.

12. Claims 4-5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kolawa (US 6,085,029) in view of Aberth (Aberth et al., Precise Computation

Using Range Arithmetic, via C++) in further view of Goldberg (David Glodberg, "What Every Computer Silent Should Know about Floating-Point Arithmetic")

Claim 4:

Kolawa and Aberth disclose the method of claim 3, but do not explicitly disclose the error variable is a half unit in last place (HULP) value associated with the floating-point variable. However, Goldberg in the same analogous art of floating-point arithmetic disclose the ULP and half ULP(HULP) to measure rounding error in floating-point computation (see for example, p.8 section "Relative Error and Ulps). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to use this method to represent error information. One would have been motivated to do so to perform error analysis more accurate as suggested by Goldberg (see for example, p.8, right column, "a fixed error of 1/2 ulps results in a relative error that can wobble by β")

Claim 5:

Kolawa , Aberth and Goldberg disclose the method of claim 4, Aberth further discloses wherein a value of the half unit in last place is determined using information obtained during renormalization (see for example, p.488, example code for calculating the value of floating-point variable "f").

13. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kolawa (US 6,085,029) in view of Aberth (Aberth et al., Precise Computation Using Range Arithmetic, via C++) in further view of Kahan (Prof. W. Kahan, IEEE Standard &54 for Binary Floating-Point Arithmetic)

Claim 12:

Kolawa and Aberth disclose the method of claim 11, but neither of them discloses wherein execution of the compiled instrumented code halts if the accuracy threshold is exceeded. However, Kahan in the same analogous art of IEEE Standard &54 for Binary Floating-Point Arithmetic discloses an exception INEXACT trap. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to implement the feature to halt the execution if accuracy threshold hold is exceeded. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to do so to implement floating-point related feature according the standard specification. (see for example, p.18, section Exception: INEXACT and related description)

Conclusion

14. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

- Fang et al., "Floating-point error analysis based on affine arithmetic", discloses an error analysis method that can keep track of floating point error.

15. Applicant's arguments with respect to claims rejection have been considered but are moot in view of the new grounds of rejection.

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

16. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Zheng Wei whose telephone number is (571) 270-1059 and Fax number is (571) 270-2059. The examiner can normally be reached on Monday-Thursday 8:00-15:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tuan Q. Dam can be reached on (571) 272-3695. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Any inquiry of a general nature of relating to the status of this application or proceeding should be directed to the TC 2100 Group receptionist whose telephone number is 571- 272-1000.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

ZW

TUAN DAM
SUPERVISORY PATENT EXAMINER